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## Doing more with less: Teacher professional learning communities in resource-constrained primary schools in rural China

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### Abstract

Teacher professional learning communities provide environments in which teachers engage in regular research and collaboration. They have been found effective as a means for connecting professional learning to the day-to-day realities faced by teachers in the classroom. In this paper, we draw on survey data collected in primary schools serving 71 villages in rural Gansu Province, as well as transcripts from in-depth interviews with 30 teachers. Our findings indicate that professional learning communities penetrate to some of China's most resource-constrained schools, but that their nature and development are shaped by institutional supports, principal leadership, and teachers' own initiative.

### II. Introduction

Teacher professional learning communities, or communities of practice, can be defined as environments in which teachers interact and collaborate regularly around issues of teaching and learning and engage in the production and consumption of knowledge about improved practices for student learning (Bullough, 2007; Cochran-Smith & Lytle, 1999; Henson, 2001; Vescio, Ross, & Adams, 2008; Wood, 2007). In the United States, participation in teacher professional learning communities has been shown to result in changes to teaching practices (Dunne, Nave, & Lewis, 2000; Englert & Tarrant, 1995; Hollins, McIntyre, Debose, Hollins, & Towner, 2004; Louis & Marks, 1998; Strahan, 2003). Other scholars have found that participation in professional learning communities has an impact on school professional culture and leads to increased involvement, ownership, innovation and leadership among teachers (Andrews & Lewis, 2002; Berry, Johnson, & Montgomery, 2005; Phillips, 2003; Supovitz & Christman, 2003). Professional learning communities have strengthened the connections between professional learning and the immediate needs of teachers (Berry et al., 2005; Bolan, McMahon, Stoll, Thomas, & Wallace, 2005). Evidence also suggests that teacher professional learning communities have resulted in improved student achievement (Berry et al., 2005; Bolam, McMahon, Stoll, Thomas, & Wallace, 2005; Hollins et al., 2004; Louis & Marks, 1998; Phillips, 2003; Strahan, 2003; Supovitz, 2002; Supovitz & Christman, 2003).

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While there is growing support for the fostering of teacher professional learning communities in the current policy environment (Hargreaves, 2000), the culture of teaching in the United States has long been characterized by isolation (Lortie, 1975; Meyer & Rowan, 1978; Vescio et al., 2008; Weick, 1976). Scholars studying teacher professional practices around the world have noted the variation in the degree to which educational systems support teacher collaboration and the development of teacher professional learning communities (Paine & Ma, 1993; Stigler & Hiebert, 1999; Wang & Paine, 2003). In Japan, for example, “lesson study” is an established practice that began in the early 1900s (Fernandez, 2002). Lesson study consists of teacher collaboration and systematic inquiry into teaching and learning in the context of peer observation, critique, and discussion around specific student learning objectives.

Similar norms of teacher collaboration are a part of the formal structure of the educational system in China. These activities take the form of teaching and research groups (*jiaoyan zu*, 教研组) and their associated activities (*jiaoyan huodong*, 教研活动). The activities of the teaching and research group are organized at the national, provincial, county, district and school levels. These collective activities encompass a wide array of professional development and socialization opportunities, including joint lesson planning and the sharing of resources; organized discussions of articles related to subject-specific teaching; talks given by educational experts; and district-organized demonstration lessons observed and critiqued by other teachers in the district. Teaching and research group activities appear to be utilized effectively to disseminate new curriculum and pedagogy and to share teaching strategies (Sargent, 2007a; 2007b),<sup>2</sup> though some have argued that teaching and research group activities may play a conservative role, by socializing new teachers into existing norms and practices (Paine, 1990; Paine, 1992).

China is also interesting because these organizational features penetrate throughout the system, extending from districts serving China's wealthiest “first world” urban communities to districts serving China's most impoverished rural communities. Several studies have examined the structure and role of teacher collaboration and professional learning communities in Chinese schools (Paine & Fang, 2007; Paine & Ma, 1993; Paine & Fang, 2006; Wang & Paine, 2003). However, there is little systematic empirical research on the nature of teacher participation in these activities; nor is there research on factors that contribute to the strength of these communities. Even less is known about the role of teacher professional learning communities in rural areas of China.

Teacher professional learning communities may be a cost-effective strategy for teacher professional development in impoverished communities. Many aspects of effective professional learning communities can be supported through institutional structures and incentives within schools themselves, without the need to pay for teachers' transportation and room and board to attend off-site training sessions. For this reason, cultivating professional learning communities may be a particularly desirable strategy for the improvement of teaching and learning in resource-constrained settings.

This paper investigates the nature and varying forms of professional learning communities in rural Gansu, one of China's poorest provinces, in Northwest China. We analyze survey data collected in primary schools serving 71 rural villages in June 2004, as well as transcripts from 30 in-depth interviews with rural primary school teachers collected in fall

<sup>2</sup>The finding that teaching and research group activities assist in the dissemination of reforms and innovations is congruent with the findings that lesson study activities in Japan played an important role in the transformation of teaching practices in science from traditional methods to inquiry based methods (Lewis & Tsuchida, 1997).

2004. We investigate the nature of professional learning communities in rural Gansu, and the institutional, school and individual teacher attributes that support active professionalism.

### III. Professional learning communities in theoretical perspective

#### A. A working definition

Drawing on definitions in common use in the literature, we define professional learning communities as existing when two broad categories of activities occur on a sustained basis. First, teachers must regularly interact about teaching and learning, for example, through teacher collaboration in lesson planning; through activities of joint study and discussion about teaching; or through activities of peer observation (Fernandez, 2002; Vescio et al., 2008; Wineberg & Grossman, 1998). Second, teachers must produce knowledge about teaching, through teacher research and publication (Cochran-Smith & Lytle, 1999; Henson, 2001; Wood, 2007). For Cochran-Smith and Lytle (1999), teachers who come together as researchers in professional learning communities are able to play an important role in the integration of formal knowledge of teaching, on the one hand, and practical knowledge on the other. Cochran-Smith and Lytle (1999) argue that teacher professional learning communities allow for the joint construction of contextualized knowledge of practice through conversation and writing. This collaborative analysis and interpretation is able to “make visible” and understandable day-to-day events, and the norms and practices of teaching.

#### B. Supporting professional learning communities

Various factors may determine the success and sustainability of teacher professional learning communities, including institutional features of the educational system (Chubb & Moe, 1990; Paine & Ma, 1993; Stigler & Hiebert, 1999), principal leadership characteristics (DuFour, 1999; DuFour & Berkey, 1995; Huffman, Hipp, Pankake, & Moller, 2001; Printy, 2008), school socioeconomic factors, and individual teacher characteristics (Dooner, Mandzuk, & Clifton, 2008; Westheimer, 1999).

First, institutional characteristics can facilitate or hinder professional learning communities in the degree to which they provide time and space for teachers to engage in collaboration. Institutional characteristics include the norms of the national and professional culture and, consequently, the time that is built into the system for teachers to engage in professional community building activities (Chubb & Moe, 1990; Lortie, 1975; Paine & Ma, 1993; Stevenson & Stigler, 1994; Stigler & Hiebert, 1999; Wang & Paine, 2003). Darling-Hammond's (2008) recent editorial comparing teacher professional learning communities in Singapore and in the United States highlights the lack of support for stable, consistent, coherent, sustainable professional learning communities in the United States: “[In Singapore,] expert teachers are given time to serve as mentors to help beginners learn their craft. The government pays for 100 hours of professional development each year for all teachers. In addition, they have 20 hours a week to work with other teachers and visit one another's classrooms...Most U.S. teachers, on the other hand, have no time to work with colleagues during the school day. They plan by themselves and get a few hit-and-run workshops after school, with little opportunity to share knowledge or improve their practice.” Logistical constraints—lack of time and space—are important challenges for teacher collaboration in the United States, and likely reflect the lack of a broader commitment to enabling professional learning communities (Cochran-Smith & Lytle, 1999; Darling-Hammond, 2005). If teachers are to come together to engage in research and collaboration, they need to be given adequate amounts of time to do this regularly and over sustained periods.

Other variables within the school system also present incentives and disincentives for collaboration. In the current context of teacher accountability pressures in the United States, student examination scores have become increasingly important forces driving classroom teaching. In China, too, exam scores are highly consequential for student upward mobility, and teacher professional evaluations commonly include consideration of student exam results. The importance of exams in both settings raises the question of whether examination pressure makes teachers more receptive to drawing on each other's support to foster student learning, or whether it generates time pressures that discourage teachers from taking the time to collaborate and interact with each other in professional learning communities.

The policy environment in which schools operate also has implications for institutional support for teacher collaboration. In China, the policy environment for teacher collaboration is undergoing change. A recent reform known as the New Curriculum Reforms (*Xin kecheng gaige*, 新课标改革) has sought to bring about a transformation of many dimensions of teaching practice, and the teaching and research groups at the county, township and school level have been mobilized to assist in the dissemination of the new norms and practices called for by the reforms. The reforms have aimed for an overhaul of the structure and content of basic education (Grades 1 to 12) and a transformation in curriculum, pedagogy and beliefs about teaching and learning (Shi and Liu, 2004; Sargent, 2007a; Forthcoming). During the period covered by this project, the New Curriculum Reforms were still being phased in. The reforms began experimentally in 2001, starting first with national pilot counties, and then following with provincial pilot counties. Finally, all counties were to begin implementation by 2005. In each county, implementation of the new reforms also began gradually, in some cases with a few schools starting ahead of other schools. Implementation within each school was phased, beginning first with grade one of primary school and grade one of junior middle school. Throughout the implementation phase a posture of learning has been promoted in which teachers are encouraged to experiment boldly, and engage in discussion and investigation of the best approaches. Open classroom activities and demonstration lessons are also a common technique for the investigation and spread of New Curriculum practices. Challenges faced by the implementation of the New Curriculum reforms may also spark greater interest and investment in teacher research. If the policy shift is achieving its stated goals, we would anticipate that teachers working in schools operating under the New Curriculum framework are more likely to be participating in professional learning communities.

Scholars have also found principal leadership to be an important factor that can support or impede teacher professional learning communities (DuFour, 1999; DuFour & Berkey, 1995; Huffman et al., 2001; Printy, 2008). Researchers have suggested that principals can nurture and develop teachers' professional growth as part of the school culture by creating consensus, promoting shared values, ensuring systematic collaboration, encouraging experimentation, and promoting the self-efficacy of teachers (Deal & Peterson, 1990; DuFour & Berkey, 1995; Wineberg & Grossman, 1998). Principal leadership can support the culture and the organizational mechanisms by which teachers talk about teaching and learning, observe each other teach, plan, design, research, and evaluate curricula, and teach each other what they have learned about their craft (Barth, 1990; Deal & Peterson, 1990; DuFour & Berkey, 1995; Wineberg & Grossman, 1998).

It is also possible that the ability to establish and maintain professional learning communities for teachers may be dependent on the availability of financial resources in the school, although, to our knowledge, no empirical research has investigated this relationship. For example, schools with fewer resources may have a harder time attracting a sufficient number of qualified teachers, a circumstance leading to heavier teaching loads for the teachers. This situation may mean less time for collaborative activities such as lesson

planning and group study. Under-resourced schools may not be able to support teachers to attend professional learning community activities outside the school and teacher research may also be hindered if teachers lack easy access to computers and reference materials.

Finally, the individual initiative and attitudes of teachers may matter (Dooner et al., 2008; Westheimer, 1999). Individual teachers may have particular characteristics that predispose them to becoming more active in participating and initiating activities of professional communities. These characteristics might include teachers' family commitments outside of school and their ability to devote extra time to engagement in professional community activities.

## IV. Data and methods

We investigate professional learning communities and the institutional, leadership, school and individual characteristics that support them using qualitative and quantitative data from rural primary schools in the remote interior province of Gansu. With analysis of transcripts from qualitative interviews, we investigate the extent to which professional learning communities are viewed by teachers as a regular part of their lives and illustrate the diversity of forms of professional learning communities. With analysis of survey data, we investigate the prevalence of types of activities associated with professional learning communities. We also investigate the characteristics of schools, principals, and teachers themselves that are associated with these indicators of professional learning communities.

### A. Qualitative data

The 30 teacher in-depth interviews for the qualitative component of this study were collected in 11 schools in six rural counties across Gansu in fall 2004. The six counties were purposefully selected to obtain diversity along the dimensions of wealth, geographic location, and whether or not they had already begun implementing the New Curriculum Reforms. Within the counties, schools were purposefully selected to achieve diversity with regard to access to socioeconomic resources<sup>3</sup> and also by remoteness from the county seat. In-depth interviews with each of the teachers were conducted immediately following an observed lesson. Interviews were recorded with permission and transcribed. Table 1 illustrates characteristics of the teacher in-depth interviews data that were collected by grade level, subject, curriculum reform implementation status, and school type.

Interviews were analyzed using NVivo qualitative data analysis software and were coded for instances when teachers spoke about their participation in professional learning community activities as well as about their research and publishing activities. Excerpts from the interviews are presented that provide descriptions of the nature of the various types of activities that are found to be prevalent in both the survey and interview data as well as to illustrate the variation in nature and frequency of these activities.

### B. Survey data

Survey data come from the teacher and principal censuses for wave 2 of the Gansu Survey of Children and Families (GSCF), which was collected in the summer of 2004. The GSCF is a unique data set providing a rich source of information about children's educational contexts and outcomes. The teacher census was an add-on, stand-alone component to the

<sup>3</sup>Three main types of schools are found in rural Gansu: central schools, village schools and teaching point schools. In general, each township has one central school that has access to greater financial and human resources and some responsibilities for supporting the other schools in the township. Village primary schools are usually complete schools with grades from 1 to 6 and teaching point schools generally provide the first two to four years of schooling in the village so that young children do not have to travel long distances to the village or central schools. In collecting the qualitative interview data we visited all three types of schools.

study, for which the sample consisted of a three-stage stratified systematic sample: first counties were selected, then townships, then villages. Survey questionnaires were administered to a census of the teachers in all the primary schools in the sampled villages, as well as to the principals and village leaders. After dropping schools with fewer than five teacher observations per school (27 schools and 74 teachers) and dropping other cases with missing data (11 teachers), our analytic sample consists of 646 teachers in 73 schools; schools were located in 71 villages, within 50 townships located in 20 counties.

### C. Measurement and modeling

**1. Dependent variables**—Table 2 shows descriptive statistics for variables used in the quantitative analysis. Our outcome variables consist of several measures of participation in professional learning communities. The first outcome measure of participation in professional learning communities is a scale constructed out of 7 items that measure frequency of participation in teaching and research group activities in the teacher's own school, teaching and research group activities in another school or at the district level, peer observation, model lessons, study sessions organized in the school, or short term training sessions held at a teacher training institute or provided by an educational expert. There are four possible responses to each item that measure the frequency of participation during the past year in particular activities of the teaching and research group: 0=never, 1= once in the past year, 2=one to two times a semester, 3=once a month, 4=once a week. The responses of all teachers to each of the items are standardized to have a mean of 0 and a variance of 1. For each individual teacher, the standardized scores of each item are then summed to generate a value representing degree of participation in professional learning community activities. The scale of teacher participation in professional learning communities has a Cronbach's alpha of 0.72. The distributions of each of the dichotomized professional development variables are shown in table 2.

Based on the working definition of professional learning communities laid out above, we also use two additional indicators, not part of our scale: teacher reports of whether or not they plan their lessons with other teachers (coded 0, 1), and whether or not the teacher has published an article (coded 0, 1).

**2. Independent Variables**—In our quantitative analysis, we focus on four categories of factors that we theorize to be related to variation in the strength of professional learning communities in rural China: institutional factors, principal leadership, school socioeconomic status, and individual teacher characteristics. Institutional characteristics are all measured at the school level. Institutional characteristics that have been considered important for the facilitation of teacher professional learning communities include the amount of time that teachers spend teaching classes relative to the time they have available for planning and collaboration. We include in the analysis a variable for average class hours per school, and include average class hours squared in multivariate analysis to allow for nonlinearity of the effect (for class hours to have an increasing and then a decreasing effect on indicators of professional learning communities). The average number of classes taught per week is 22 (standard deviation=4.31), which leaves a great deal of time for teachers to spend planning, grading homework and engaging in activities of professional communities.

Other institutional characteristics include the percentage of the teacher's evaluation that is dependent upon the students' examination scores (63 percent on average, with a standard deviation across schools of 26 percent); and the extent to which the New Curriculum Reforms are being implemented in the school. This latter variable is measured using an item in the teacher questionnaire that asks teachers to report whether or not their school is undertaking a full implementation of the new reforms. Teacher reports of reform



implementation are then aggregated to the school level to create a school level score that represents the proportion of teachers in the school who report full reform implementation. There was some within-school variation in response to this question. As the new curriculum reforms were implemented only gradually into the schools in the experimental phase of implementation during the period 2001-2005, teachers in lower grades began full implementation earlier than other teachers. This situation likely explains the within-school differences in responses regarding the extent of reform implementation in the schools. However, aggregation of this teacher-level variable to create a reform implementation score at the school level creates a potentially strong indicator of the level of awareness and engagement with the reform implementation within the school. On average, based on this measure, the proportion of teachers reporting full reform implementation in the schools in our sample was .30 (SD=.26).

Also included in this set of variables is the variable “common teacher office,” which is a school-level variable indicating whether or not the school has a common office for teachers to use. In many schools, as a means for encouraging teacher interactions, teachers work together in a common office. In our sample, there is a common teacher office in 52 percent of the schools.

In the multivariate analyses, as measures of the characteristics of principal leadership we include years of principal education and years of principal teaching experience. On average, principals have 13 years of education (SD=1.61 years) and 24 years of teaching experience (SD=9 years). The strength of principal leadership is operationalized using the school-level mean of a scale of 18 items from the teacher questionnaire which are teacher reports of principal behaviors. Individual components of the scale can be seen in table 2. These components include aspects theorized to be important for facilitating flourishing professional learning communities, such as the principal's ability to create consensus, promote shared values, ensure systematic collaboration, encourage experimentation, and promote the self-efficacy of teachers (DuFour, 1999; DuFour & Berkey, 1995; Printy, 2008). Items related to these characteristics include the principal: “encourages me to use a range of different teaching strategies;” “has high expectations of me;” “respects me;” “emphasizes the importance of cooperation among teachers;” “interacts with faculty and staff and makes them aware of their importance to the school;” and “is very capable in organizing the teachers to work together.” Other indicators of effective leadership also included in the scale are listed in table 2.

This scale was constructed using the same procedure as described for the professional development scale above (Cronbach's alpha = 0.88). Analysis of variance indicates that 34 percent in the variability of the principal leadership scale reported by teachers occurs across schools,  $F(72, 573)=4.08$ ,  $p<0.0000$ . We then aggregated individual teacher scores to the school level by taking the mean of the scores of all the teachers in the school. There is considerable variation in the school aggregated reports of principal leadership. The mean of the scale across all schools is 0.01 and the standard deviation is 0.35.

School socioeconomic status is operationalized using six variables: schools' semester expenditure per student, total number of teachers who teach classes, percent of the teachers who have tertiary level educational attainment, number of computers that the school owns, number of books in the library, and the distance from the county seat. On average, schools in rural Gansu spend 37 Yuan per student per semester (SD=46 Yuan) and 33 percent of teachers have tertiary education (SD=27 percent). The average school owns 3 computers (SD=7.59) and in 46 percent of these schools principals report that teachers use the computers to collect materials which could be used for both teaching and for research purposes. The average rural school in Gansu province has 1972 books in their library

(SD=3191 books). In the multivariate analysis, we include the number of teachers in the school as a control; the smallest schools are likely to be serving the poorest, most remote communities. In our analytic sample, there are about 12 teachers per school (SD=6 teachers) and the average distance of the school from the county seat is 26.64 km (SD = 20.82 km).

Finally, we consider teacher individual characteristics. We examine the extent to which participation in professional learning communities is more prevalent among teachers recognized as highly accomplished practitioners. In yearly evaluations, teachers can receive an evaluation as excellent, good, pass, or fail. We construct a measure for “excellent teacher” that is defined by whether or not the teacher has received an evaluation of excellent (*youxiu*, 优秀) teacher at least once in the last four years. In our sample, 39 percent of the teachers fit this definition of excellent teacher. In the multivariate analysis, we also include various teacher characteristics as controls, including whether or not the teacher is a female, whether or not the teacher comes from the town where the school is located, and teacher age. In our sample, 47 percent of the teachers are female, 82 percent are married, 62 percent come from the same township where they are working, and the average teacher age is 37 years old.

**3. Models**—Our modeling approach uses random effects models, a subcategory of hierarchical linear models or multi-level models, to account for the non-independence of observations within schools. For our first outcome, the continuous professional development scale, we use the *xtreg* procedure in Stata to estimate the random effects models:

$$y_{st} = \mathbf{x}_{st}'\boldsymbol{\beta} + u_s + \varepsilon_{st}, \quad (1)$$

where  $y_{st}$  is the outcome measures for individual teacher  $t$  in school  $s$ ,  $\mathbf{x}_{st}$  is a vector of school and teacher characteristics with corresponding parameter vector  $\boldsymbol{\beta}$ , and  $u_s$  and  $\varepsilon_{st}$  are error terms at the school and individual levels, which are normally distributed with mean of zero and variance  $\sigma_t^2$  and  $\sigma_s^2$ . We also estimate a within-school fixed effects specification, in which  $u_s$  is not treated as a random term but rather as school-specific intercept, to check effects of teacher characteristics while accounting for potential unmeasured differences at the school level. For the two of three dependent variables that are binary measures, namely whether teachers plan their lessons with other teachers and whether or not the teacher has published an article, we employ the *xtlogit* procedure in Stata to estimate analogous random effects logit models.

For each outcome, we present six models. The first four models enter in turn each of the four categories of variables thought to matter for professional outcomes: institutional factors (model 1), principal leadership (model 2), school socioeconomic status (model 3), and individual teacher characteristics (model 4). The fifth model re-estimates model 4 with fixed effects instead of random effects for schools, to check the impact of individual teacher characteristics with controls for cross-school unmeasured differences. The final model (model 6) is a full model, with all categories of variables included, and a random effects specification. Model 6 allows us to compare results with models 1 to 4, to consider, for example, the association of principal leadership with the outcome variables before and after controlling for institutional arrangements (in which principals likely have some say).

For ease of interpretation, the tables for models with binary outcomes (collaboration or publishing) also present marginal effects calculated based on the full model (model 6). We calculate marginal effects at the mean with random effects assumed to be zero, using the *mfx* routine in Stata. The marginal effects illustrate the change in predicted probability of the



outcome (collaboration or publishing) associated with a one-unit change in each predictor, with all other predictors held at mean values.

## V. Findings

### A. A portrait of professional learning communities in rural China

Teachers in China engage regularly in a wide range of professional development activities, including specific short term training activities, but also the range of “teaching and research activities” which constitute the core of professional learning communities in Chinese schools. These activities include collective lesson planning; peer observation and evaluation and critique; observation of demonstration or model lessons, including the watching of videos of model lessons; and the production and consumption of research about teaching and learning, including by publishing articles in school, township, county, district, provincial and national newsletters, newspapers and journals.

Statistics displayed in table 2 and figure 1 indicate that 52 percent of teachers participate in teaching and research activities within the school at least once a week, and over 70 percent of teachers report participating in these activities at least once a month. 84 percent of teachers in our sample agree with the statement that “the teaching and research activities in the school are very valuable.” However, as can be seen in figure 1, there is substantial variation across teachers in the degree to which teachers have frequent opportunities to engage in these activities. Some of this variability will occur across teachers within the same school environments, but analysis of variance indicates that 30 percent in the variability of the professional development index occurs across schools,  $F(72, 573)=3.38, p<0.0000$ .

Data from the teacher in-depth interviews also reveal differences across schools in the strength of professional learning communities. In interviews, it was clear that the notions of collective lesson planning, peer observation, demonstration lessons and teacher research were familiar ideas to all the teachers. However, the regularity with which such activities were actually engaged in varied greatly across the eleven schools. In four of the schools teachers engaged in a regular and demanding schedule of professional learning with two or more activities arranged per week. A teacher at Longkou Teaching Point<sup>4</sup> explains the frequency and nature of the teaching and research activities that are held at his school:

“Yes, [teaching and research activities are held] twice a week... We study new ideas about teaching and learning or excellent examples of New Curriculum classrooms... Usually we have our teaching and research group meetings in the evening after class at 7 to 8pm on Mondays and Wednesdays... This Monday we watched a model lesson on the computer through the satellite... It was taught by a teacher in Beijing... I was deeply impressed. After watching this class I was made to realize the gap between my own level of teaching and the level of this teacher's teaching... All of the teachers [in the school] come to watch. It is quite rewarding to watch the lessons. We take notes and then after we finish watching we discuss our understandings.” (Male 2<sup>nd</sup> grade Math teacher at Longkou Teaching Point, paragraphs 39-44)

In other schools, teachers interviewed suggested that heavy teaching loads made the holding of these activities less frequent and less emphasized, as seen in these two excerpts:

“Usually it is only once every two weeks, or sometimes only once every three weeks because teachers are all too busy and there is too great a shortage of

<sup>4</sup>All school names used in this article are pseudonyms. Teachers are identified according to grade and subject taught based on the lesson that was observed prior to the interview. Most teachers, however, teach more than one grade and often more than one subject.

teachers. We don't even have time to take care of all the students... (Female 1<sup>st</sup> grade Chinese teacher at Chenyang Central School, paragraph 157)

"In the rural areas we have a great burden of lessons...this period I have a lesson, next period [the other teachers] have a lesson, so there are very few opportunities to exchange ideas with each other." (Male 5<sup>th</sup> grade Chinese teacher at Jiangnan Village School, paragraphs 95-122)

One of the specific activities included under the heading of teaching and research activities is the practice of joint lesson planning. Table 2 shows that 24 percent of the teachers in our survey sample plan their lessons with other teachers as their main form of lesson planning. Likewise, in the qualitative data, we find that in most cases teachers report that they generally plan their lessons on their own but there are numerous instances where teachers in schools work together to plan lessons. This is more likely to occur in larger schools where there is more than one teacher per subject for a grade level, in which case the teachers can work together in the planning of the same lesson. In one central school, weekly joint lesson planning sessions form the main type of teaching and research activity and this is facilitated by the presence of a common teacher office:

"Each week we organize a big joint lesson planning activity and then everyone spends time in their own individual study..." (Female 3rd grade teacher at Xishan Central School, paragraph 43)

Another teacher at the same school explains:

"In our school, we have just one office and so we all sit together. The school organized it like this so that all the teachers who teach the same grade can sit together and whether it is during the formal teaching and research activities or outside these formal activities it is good for the teachers. Often, when we are preparing for classes, we all exchange our ideas. For example, if I feel something was successful for me in teaching these several classes we can all try it out. And if, in designing this lesson, I come across some problems... then I can benefit from another teacher's experience...Just very casual interaction but it is very convenient." (3rd grade Chinese teacher at Xishan Central School, paragraph 118)

All teachers interviewed who have experienced joint lesson planning express positive sentiments towards it. For example:

"I think that individual lesson planning has its own advantages, but I think that I prefer joint lesson planning...when you plan your lessons on your own, you are not able to consider all of the important aspects as comprehensively." (Male 3<sup>rd</sup> grade English teacher at Longkou Teaching Point, paragraphs 164-177)

Another key element of professional learning and teaching and research activities in China is frequent peer observation followed by discussion and critique. For example, 37 percent of the teachers in our survey sample report participating in peer observation activities at least once a week, and over 90 percent of teachers in the sample indicate that they participated in such activities at least once or twice a semester (Table 2 and Figure 1). In addition, teachers occasionally have the opportunity to observe demonstration or model lessons designed for the explicit purpose of learning new techniques from the teacher delivering the lesson. Fully 80 percent of the teachers in our survey sample report participating in such an activity at least once or twice a semester in the past year (Figure 1). Teacher in-depth interviews indicate that all teachers have experience with this type of activity. The following excerpts from teacher interviews reflect the frequency of such activities in some schools, and the degree to which they extend beyond the school to facilitate the interaction and exchange between teachers from different schools:

“Every Thursday...they don't tell you ahead of time whose lesson is going to be observed...they only tell us on Thursday whose class will be observed that day and they move the chairs in and everyone observes that class...Every week we have it and after we have observed the lesson we must write up our comments and then have a discussion...and the teachers all put any constructive suggestions they might have out there and whatever needs to be learned is learned and whatever needs to be removed from the lesson is removed.” (Female 2<sup>nd</sup> grade Chinese teacher at Liuye Village School, paragraphs 93-95)

“Every week on Wednesdays, the teachers in the whole township will go to observe one class and after the class will discuss it...we also organize a classroom observation in our own school once a week. Afterward, we observe and point out the aspects of the lesson that are not adequate and the main areas in need of improvement.” (Male 3<sup>rd</sup> grade English teacher at Longkou Teaching Point, paragraphs 192-199)

Demonstration lessons are a part of the formal training activities that have been organized to bring about the implementation of the New Curriculum reforms:

“Beginning last year, our school sent some teachers to participate in the [New Curriculum] training sessions. Currently, grades 1 to 3 are New Curriculum experimental classes. All of these teachers were sent for training, including myself...Even some of the older teachers went to participate. Their thinking is a little outdated, so through observing some New Curriculum classes, some of their previous fixed ideas were challenged, they acquired the desire to overcome the limitations of their previous teaching styles, and they have gradually come to understand the goals, meaning and ...methods of the New Curriculum. I also learned a great deal from the training.” (Male 2<sup>nd</sup> grade Math teacher at Longkou Teaching Point, paragraph 48)

A third critical element of professional activities in China is publication of teacher research. Teachers at all levels are expected to participate in the production and consumption of knowledge about teaching and learning. Teachers disseminate their research in publications that are ranked by prestige according to whether or not they are national level, provincial level, municipal district level, county level, township level or school level. 68 percent of the teachers in our survey sample indicate that they engage in research on teaching and learning (our calculations, not displayed in table), and 24 percent of the teachers report having published an article (Table 2). Three-fourths of principals in our survey sample report that teachers' teaching and research activities are taken into account for year-end evaluations.

Teacher in-depth interviews allow some insight into the nature of this research, the kinds of topics that teachers' research, and their incentives and motivations for writing their papers and choosing their topics. 11 of the 30 teachers in the qualitative component of the study report having published articles, but these teachers were working in only 4 of the 11 schools. Almost all of the teachers indicate that they are encouraged, if not required, to write articles by their principal, by the school district, or by the county education bureau. Several of the teachers interviewed express that they find this task challenging. A teacher in a central school in a mountainous and remote minority autonomous county states that she hasn't written anything, but voices the following concerns:

“The school asks us to write two articles a semester...but this is a lot... Teachers are all rather busy. Really, it is rare to find the opportunity to have enough quiet and stillness to write an article. After classes every day we have homework to grade, and lessons to plan. This takes up all of our free time...If we manage to keep up with all of this, sometimes, we can write some reflections on our teaching and

use some excerpts from these in our articles.” (5th grade English teacher at Chenyang Central School, paragraph 137-156)

Enthusiasm for publishing seems to vary greatly by school and may depend heavily on the extent to which the principal in the school places emphasis and provides support for publishing. The teachers in the qualitative sample with the most successful record of publication are all found at Liuye Village School. The three teachers who were interviewed at this school have all published articles in national- and provincial-level journals such as “Teaching and Management” (*Jiaoxue yu guanli*, 教学与管理) and “Educational Forum” (*Jiaoyu luntan*, 教育论坛). Topics of these published articles include “Developing students’ thinking abilities through small group work,” “A lesson in fairy tales” and “Constructing a system for extracurricular reading in rural primary schools.” Teachers in three other schools also have publication records in municipal level teacher journals or in publications at the township and school level.

Interviews with teachers who had published indicate that the choice of topic seems to depend largely on the teachers’ own interests. A teacher at Longkou Teaching Point, for example, explains his motivation for writing about his topic:

“We need to place importance on knowledge gained through experience. Human intelligence is one of the factors in personal growth, but personal experience is also very important. If a person does not have experience, their access to information is very limited; if they spend all of their time at home it is not healthy for their development....[I chose this topic] because I would like to gain more knowledge through experience myself. You become a well-informed person if you have more information gained through your personal experience...” (Male 2<sup>nd</sup> grade math teacher, Longkou Teaching Point, paragraphs 75-80)

Sometimes, teachers’ interests are shaped by issues, problems, or strengths they perceive in their own schools. A teacher at Tangyang village school, which is located just outside of a prosperous county town, mentions that he has published a piece in the municipal district level journal *Jiuquan Education Magazine* (*Jiuquan jiaoyu zazhi*, 酒泉教育杂志). The title of the article was “Preliminary discussion of the cultivation of students’ capacity for memorization in the mathematics classroom.” The teacher explains his motivation as follows:

“[I chose this topic] because I felt that some teachers do not emphasize the cultivation of students’ memorization in mathematics class, but actually I think that ability to memorize is very important for mathematics classrooms. There are some things that if students memorize completely it will make it much more convenient for them to use them.” (Female 3<sup>rd</sup> grade Chinese teacher at Tangyang Village School, paragraphs 103-114)

Another teacher at the same school built a research project around a strength of the school. In this situation, teachers work together on group research projects, and this collaboration can lead to publication:

“Every week on Thursdays we meet for two hours. Each of us has a research topic. This year, I haven’t decided on my topic yet. Last year, we had groups of three people each working on a common topic...I studied the topic “Using multimedia to raise the quality of teaching and learning” because this topic is currently rather new. In addition, the use of multimedia in our school is among the best in the county, so I was studying this topic...Usually we make use of multimedia in the classroom and see if we can use it to raise students’ level of engagement, and observe the results..” (Female 2<sup>nd</sup> grade Chinese teacher at Tangyang Village School, paragraph 84-86)

In summary, there are institutional norms and structures in place for teachers in rural primary schools in China to be engaging in collaborative activities that enable the construction of professional learning communities. The types of activities that teachers engage in include activities within and outside the school and take various forms. Teachers interviewed discuss activities including peer observation and critique; demonstration lessons; joint lesson planning activities; and teacher research about teaching and learning. While the evidence suggests subsets of these activities are commonplace across all schools in our survey and qualitative samples, the nature and frequency of specific activities vary across schools.

## VI. Factors that support professional communities

What, then, are the factors that are associated with the development of professional learning communities across schools in rural China? We now present an analysis of survey data to explore the institutional, principal, school, and teacher characteristics associated with active professional communities in primary schools in rural Gansu. We present random effects regression models of the professional development scale and random effects logit models of teacher reports of collaboration on lesson planning and teacher publishing.

### A. Institutional environment

First, we investigate the effects of measures of institutional supports for professional communities. We include a measure of school average class hours and class hours squared, the percentage of teachers' evaluation that is based on exam scores, the proportion of teachers reporting full implementation of the new curriculum reforms, and whether or not there is a common office.

Among these variables, we find significant results suggesting that class hours has a curvilinear relationship with the professional development scale, with a positive effect that turns negative as the average teaching hours increase (table 3). A weaker pattern emerges in table 4 for the models of teacher collaboration in lesson planning, though here, the effects only achieve marginal significance in model 1 and are insignificant in the full specification (model 6). More importantly, we find significant positive effects of New Curriculum Reform implementation in the models of the professional development scale (table 3) and collaboration (table 4), though not for publishing (table 5). For the professional development scale model (table 3), the effect drops to marginal significance in the full model, suggesting that some of the effects of reform are linked to other aspects of school resources or organization. However, for the teacher collaboration models in table 4, the effect remains highly significant even in the full specification (model 6). The marginal effects presented in the final column in table 4 indicate that, with other characteristics held at means, moving from non-implementation to complete implementation of the new curriculum reforms is associated with about a 38 percent increase in the probability of collaboration.

These findings may reflect an increased reliance on support from and collaboration with other teachers to meet the challenges posed by the requirements of the New Curriculum reform implementation. Teacher in-depth interviews suggest that teachers get together more often to discuss the issues they are facing as they implement new approaches to teaching. One teacher talks of how the county education bureau is trying to set up a network so that teachers in different schools across the county who are beginning to use the new curriculum materials can share their lesson plans with each other online. A principal in another school states that all the focus of teaching and research in their school is to help the first grade teachers implement the “experimental” lessons of the new curriculum.<sup>5</sup>

In models of the professional development scale and teacher collaboration, no other predictors achieve significance at conventional levels (the .05 level or better) in any specification. For publishing, among institutional characteristics, only the presence of an office is associated with publishing (table 5) and only in model 1, prior to controlling for all characteristics in model 6.

## B. Principal characteristics

Model 2 in each of the tables focuses on principal characteristics. Here, we consider education, experience, and school aggregates of teacher reports of principal leadership. For the professional development scale (table 3) and for teacher collaboration (table 4), we find that only the principal leadership measure matters at conventional levels. For the professional development scale outcome, this result disappears in the specifications that control for other school and individual characteristics, likely due to the associations among principal leadership and other favorable school characteristics. For the teacher collaboration outcome, the principal leadership measure remains highly significant in the full specification (model 6). With all predictors held to mean values, an increase of one unit in the principal leadership scale is associated with about a 34 percent increase in the probability of collaboration. For publishing, neither principal leadership nor other principal characteristics are significant at conventional levels.

## C. School socioeconomic status

Next, we investigate the potential link between school socioeconomic status, on the one hand, and professionalism, on the other. Our measures include the size and educational composition of the teacher work force, per pupil educational expenditures, and distance to the county seat. Taken together, these variables do not significantly predict any of the three professional learning community outcomes at conventional levels, with one exception: publishing is associated with the educational composition of the teachers in schools. The marginal effects show that, with other characteristics held to mean values, moving from a hypothetical school where no teachers had higher education to a school where all teachers have higher education increases the probability of publishing by about 31 percent. This effect might occur through normative means, or it may emerge if teacher educational composition is picking up dimensions of school economic status unmeasured by per pupil expenditures or other socioeconomic variables. The only other suggestion of an economic basis for professional learning communities is a marginally-significant finding that expenditures per student matters in the professionalism index model, but this effect does not achieve significance at conventional levels. These findings suggest, by and large, that school socioeconomic status is not a dominant determinant of likelihood of professional learning activities, though the educational composition of teachers in schools shapes the types of activities that are common.

## D. Individual characteristics

Finally, we consider teacher individual characteristics, including background characteristics of gender, age, origin in the same township, and marital status, and also a measure of whether the teacher has achieved the *youxiu* or excellent teacher status in the past four years. Model 4 includes school random effects, and model 5, school fixed effects, to more fully account for cross school differences in context. For the two models with binary outcomes, the sample size drops in the fixed effects specification, as schools lacking variability in the outcome are dropped. In both random and fixed effects specifications, there is a significant

<sup>5</sup>An alternative situation that could lead to these results would be if schools with high levels of teacher collaboration were selected for early roll-out of curriculum reforms. We have controlled in our models for many other dimensions of schools that might have been sources of selection for early roll-out.



positive effect of excellent teacher status on the professional development scale and on publishing, net of other characteristics in the model. This finding might be interpreted as supporting the importance of teacher agency in cultivating professional communities. It could also emerge if schools are rewarding prior “professional” behavior by granting excellent teacher status to teachers who have engaged in professional learning communities. In this interpretation, the finding is consistent with the notion of rural Chinese schools providing institutional incentives for professionalism. There is no association with collaboration, net of other controls in the models. However, excellent teachers are more likely to pursue other types of professional learning community activities. Excellent teachers are much more likely to have published an article (table 5)—marginal effects based on the full model specification (model 6) indicate that their probability of publishing increases by about 10 percent compared to teachers without this designation, with other variables held at mean values. This latter relationship makes sense, but may suggest again that causality goes both ways, as the fact that teacher rates of research and publication are also taken into consideration in year end evaluations.

Finally, some of the teacher background characteristics also matter for publishing. Teachers from the same township where they are teaching are more likely to publish, with results significant at conventional levels in the school fixed effects specification and in the full model. Teachers who are married are significantly more likely to publish in model 4, the random effects specification with only teacher characteristics included, but this effect drops to marginal significance in the fixed effects and full specifications (models 5 and 6). If we assume that most married teachers are married locally, it is possible that these findings emerge because teachers who are from or married into local communities are more likely to be networked to local publishing venues. It is also possible that such teachers are more invested in local publishing than teachers unrooted and unsettled in the local communities.

## VII. Conclusions

In China, professional interactions are structured into the educational system in the form of teaching and research activities that are organized at the national, provincial, county, district and school levels. Institutionally-supported activities encompass a wide array of professional development and socialization opportunities including joint lesson planning and the sharing of resources; organized discussions of articles related to subject-specific teaching; talks given by educational experts; and demonstration lesson activities that are organized at various scales from the level of the school district up to the provincial and even national levels. Furthermore, there is a prevailing norm of teacher research on teaching and learning, which engages teachers in the professional activity of the production and consumption of knowledge about the teaching profession.

Our findings suggest that professional learning communities are thriving even in one of China's most resource-constrained rural regions. Engagement in professional learning communities is associated with strong leadership of the principal as reported by teachers, policy reforms that fully engage the structures of teacher professionalism in dissemination and experimentation of innovations in teaching, and the initiative of teachers themselves. At the individual level, our key finding that teachers rated as excellent in the past four years are more likely to actively participate in professional learning communities and to publish may also speak to the importance of institutional supports. It is these excellent teachers who are the trainers, the teachers who conduct the demonstration lessons, and those who are most active in consuming and producing teacher research. The interplay of individual initiative, supports for teacher exchange and training, and sustained institutional efforts at building professional learning communities are illustrated in the excerpt of an interview with one

such excellent teacher who plays an active role in facilitating professional learning communities aimed at implementing New Curriculum Reforms:

“I feel that most teachers, myself included, are ordinary people. We want to discuss very practical problems. After I conduct training sessions, I feel that the teachers who participate in the implementation of the New Curriculum reforms are passionate and enthusiastic. All sectors of society must protect this passion and enthusiasm otherwise if it is lost it will be very difficult to implement the new reforms.” (Male 3<sup>rd</sup> grade math teacher at Xishan Central School, paragraphs 189-210)

In earlier years, scholars have raised concerns that the structure of the teaching and research activities has acted as a force for the maintenance of the status quo of traditional teaching, as the pressures of being observed and critiqued by more senior teachers and administrators coerce new teachers into adapting to accepted norms and practices (Paine, 1990; 1992). On the other hand, our findings in this study, as well as earlier research conducted in Gansu (Sargent, 2007a; 2007b; 2009, forthcoming), suggest that teaching and research activities are instrumental in the dissemination of educational innovations. Indeed, programs of teacher professional development and the role of teacher professional learning communities have been central to the government's strategy for the implementation of the New Curriculum reforms; the main aim of which is the transformation of teachers' teaching beliefs and practices (Sargent, 2007a, 2009, forthcoming). New Curriculum training sessions are frequently highly interactive affairs. There are lectures and presentations by educational experts, but a main mechanism is an exposition of demonstration or open lessons where a number of excellent teachers from around the district or county gather together to put on demonstration lessons across all the subjects. Other teachers from throughout the district, county or region come to observe. After the lessons, the performing teacher will share her thoughts and motivations for the design of the lesson. An educational expert, sometimes from the county education bureau, might also share her thoughts and reflections on the lesson, and then all the other teachers in attendance will have the opportunity to share their critiques, suggestions, praise, questions or reflections with the demonstrating teacher and all those in attendance. Videos of New Curriculum demonstration lessons are also produced and these are available for schools across the nation to purchase and are watched and discussed during school-based teaching and research activities (Sargent, 2009). Joint lesson planning also seems to have become more important than ever in the context of the New Curriculum reforms as, in this period of uncertainty, teachers are encouraged to work together to support each other in devising new approaches to using textbook materials in their lessons.

Furthermore, it is possible that through the structure of teacher professional learning communities, teachers may have the opportunity to be more fully engaged in shaping educational norms of practice in China. It is certainly likely that the strong role of state policy in implementing curricular and pedagogical priorities frames teachers' perceptions of issues facing their own schools and their own practice. Yet, at the micro level, teachers report autonomy in selecting issues to study as part of professional development: teachers interviewed here report conducting research related to their own pedagogical interests and issues in their own schools. Teachers are actively engaged in contributing to the success of these activities either as participants, as the demonstrators of new methods, and as active observers critiquing and reflecting upon practice. Teachers engage in discussion regarding practical issues facing educators, and conduct research relevant to their own interests and to the issues facing their own schools.

At the heart of making professional learning communities thrive is the building of time and space into teacher's busy lives and priorities. As our research has shown, the time, physical space, and institutional incentives exist in China to make teacher professional communities

possible and worth teachers' efforts. In contrast, in the United States, the educational literature has been filled with discussion of the institutional and logistical barriers to regular and ongoing teacher professional interaction (Lortie, 1975; Meyer & Rowan, 1978; Vescio et al., 2008; Weick, 1976). This situation may be changing. Hargreaves (2000) has argued that the "age of the autonomous professional" in the United States is giving way to the "age of the collegial professional." In this age, professional learning communities are coming to be regarded as an effective approach to teacher professional development and have been found to be more effective in improving the quality of teaching and learning inasmuch as they keep teacher learning embedded in the life and work of the school, and intimately connected to teachers' daily challenges in the classroom (Hargreaves, 2000). More recently, there has been new policy discussion of a commitment to teacher professional learning communities in the United States. President Obama's education plan includes a proposal to improve teacher retention by working to "expand mentoring programs that pair experienced teachers with new recruits" and to "provide incentives to give teachers paid common planning time so they can collaborate to share best practices" (Obama & Biden, 2008).

For the past several decades, Americans have been looking to Asia for educational inspiration. In his recent speech on education, Obama (2009) continues the trend by citing educational success in Singapore and South Korea. Scholars have highlighted the critical role of teacher professional learning communities in the educational successes of wealthy Asian nations such as Singapore and Japan (Darling-Hammond, 2008; Fernandez, 2002; Stevenson, 1994; Stigler & Hiebert, 1999), contexts in which organizational features similar to the teaching and research activities described in this paper exist. We suggest that the policy and research community in the United States may also wish to look to the professional learning communities that exist across the wide socioeconomic spectrum served by the Chinese educational system. The research reported here offers a complementary example of how professional learning communities operate and provide needed support to teachers serving impoverished schools and communities.

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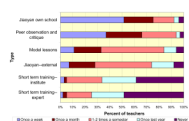
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**Figure 1. Frequency of participation in professional development**



**Table 1**

Teacher in-depth interview data collected in connection with classroom observations grade level, subject, curriculum implementation and school type

	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Total
<b>Total Subjects</b>	8	5	9	4	3	1	30
Mathematics	2	1	3	1	2	1	10
Chinese	6	4	6	3	1	0	20
<b>Curriculum implementation</b>							
Old curriculum	1	3	6	4	3	1	18
New curriculum	7	2	3	0	0	0	12
<b>School type</b>							
Teaching point (4)	3	2	2	0	0	0	7
Village (5)	4	3	3	3	3	1	17
Central (2)	1	0	4	1	0	0	6
A.							

**Table 2**

Characteristics of teacher professional learning communities, schools, principals and teachers in rural China.

Variable	Mean/Proportion (SD)	N
<b>Professional communities indicators (N=Number of teachers)</b>		
Frequency of participation in professional community activities--Scale. This scale ( $\alpha=.72$ ) is composed of seven of standardized items from the teacher questionnaire and is then aggregated to the school level. The items in the scale are on a scale from 0-4 related to frequency of participation in professional development activities during the past year 0=never, 1=once, 2=one to times a semester, 3=once a month, 4=once a week. Dichotomized versions of the items in the scale are shown below.	.062 (.57)	646
Participated in <i>jiaoyan</i> activities at own school at least once a week (0=no, 1=yes)	.52	646
Participated in <i>jiaoyan</i> activities outside the school (at another school or organized by the district) at least once or twice a semester (0=no, 1=yes)	.74	646
Participated in peer observation activities at least once a week (0=no, 1=yes)	.37	646
Participated in model lessons at least once a month (0=no, 1=yes)	.33	646
Teacher participated in a short term training course at a teacher's institute at least once in last year (0=no, 1=yes)	.62	646
Teacher participated in a short-term training course given by an educational expert at least once in the last year (0=no, 1=yes)	.52	646
Teacher participated in school level study at least once a week (0=no, 1=yes)	.51	646
Teacher generally prepares for lessons with other teachers (0=no, 1=yes)	.24	646
Teacher has published an article (0=no, 1=yes)	.24	646
<b>Institutional Environment (N=Number of schools)</b>		
Average number of classes taught per week	21.65 (4.31)	73
Percent of teacher evaluation based on students' exam scores	62.50 (26.05)	73
Average proportion of teachers in school who report that the school is fully implementing the reforms	.30 (.26)	73
There is a common teacher office in the school (0=no, 1=yes)	.52	73
<b>Principal leadership (N=Number of schools)</b>		
Years of principal education	13.0 (1.61)	73
Years of teaching experience of the principal	24.44 (9.04)	73
The principal leadership scale is made up of the following 18 standardized items from the teacher questionnaire and the scale is then aggregated to the school level. Teacher agrees with following statements about the principal (0=disagree, 1=agree):	.01 (.35)	73
<b>(N=Number of teachers)</b>		
"Encourages me to use a range of different teaching strategies"	.93	646
"Has high expectations of me"	.64	646
"Has never observed my class"	.17	646
"Allows me to participate in management decisions"	.50	646
"Has a hard time accepting new ideas"	.13	646
"Respects me"	.68	646
"Emphasizes the importance of cooperation between teachers"	.89	646
"Gives me many opportunities for personal growth"	.73	646
"Regularly holds staff meetings"	.88	646
"Has never observed my teaching but gives me advice about my teaching anyway"	.12	646
"Does not give new teachers guidance"	.16	646
"Is a good source of information about teaching and learning"	.67	646
"Interacts with all the faculty and staff and makes them aware of their importance to the school"	.77	646

Variable	Mean/Proportion (SD)	N
“The principal is very capable of organizing the teachers to work together”	.85	646
“Uses resources appropriately”	.75	646
“Uses reward and punishment to influence my teaching”	.37	646
“Works hard to improve the school environment and construct school culture”	.89	646
<b>School socioeconomic status (N= Number of schools)</b>		
Semester expenditure per student (yuan)	37.32 (45.82)	73
Proportion of teachers in the school with tertiary education	.33 (.27)	73
Number of computers in the school	3.33 (7.59)	73
Proportion of school computers used by teachers to collect materials (0=no, 1= yes)	.46	73
Number of library books	1971.86 (3191.14)	73
Average number of teachers in a school	11.99 (6.07)	73
Distance from county seat (km)	26.64 (20.82)	73
<b>Teacher characteristics (N= Number of teachers)</b>		
Teacher has received one or more evaluations as an excellent teacher in the last four years (0=no, 1=yes)	.39	646
Female teacher	.47	646
Teacher comes from same township (0=no, 1=yes)	.62	646
Teacher is married	.82	646
Teacher age (years)	36.52	646

**Table 3**  
Institutional, school, principal and teacher factors associated with professional communities-- professional development scale

	Professional development scale					
	Model 1 Institutional	Model 2 Principal	Model 3 School	Model 4 Teacher-re	Model 5 Teacher-fe	Model 6 Everything-re
<b>Institutional Environment</b>						
Number of classes taught per week	0.152* (0.076)					0.194* (0.086)
[Number of classes taught per week] SQUARED	-0.003* (0.002)					-0.004* (0.002)
Percentage of teachers' evaluation that is based on exam scores	0.001 (0.001)					0.000 (0.002)
Reform implementation status	0.448** (0.140)					0.295+ (0.165)
Common office	0.102 (0.075)					0.068 (0.085)
<b>Principal characteristics</b>						
Years of principal education		0.007 (0.026)				-0.004 (0.028)
Principal years of teaching experience		0.002 (0.004)				-0.000 (0.005)
Principal leadership scale		0.294** (0.109)				0.102 (0.117)
<b>School socioeconomic status</b>						
Semester expenditure per student			0.002+ (0.001)			0.002+ (0.001)
Total number of teachers who teach classes			-0.005 (0.007)			-0.002 (0.008)
Proportion of teachers with tertiary education			0.022 (0.166)			0.165 (0.200)
Number of computers			0.008 (0.006)			0.005 (0.006)
Number of books in the library			0.000 (0.000)			0.000 (0.000)
Distance from county seat			0.003+ (0.002)			0.002 (0.002)
<b>Teacher characteristics</b>						
Female teacher				-0.045 (0.049)	-0.046 (0.051)	-0.042 (0.049)
Teacher age				0.002 (0.003)	0.003 (0.003)	0.003 (0.003)
Teacher from same town				0.065 (0.047)	0.066 (0.049)	0.064 (0.048)
Teacher is married				-0.047 (0.064)	-0.054 (0.066)	-0.054 (0.064)
Excellent teacher				0.124** (0.043)	0.102* (0.045)	0.103* (0.044)
Constant	-1.864* (0.883)	-0.050 (0.400)	-0.069 (0.132)	-0.035 (0.103)	-0.061 (0.102)	-2.535* (1.125)
Number of observations	646	646	646	646	646	646

Professional development scale						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Institutional	Principal	School	Teacher-re	Teacher-fe	Everything-re
R2 within	0.000	0.000	0.000	0.021	0.022	0.022
R2 between	0.192	0.095	0.152	0.034	0.021	0.337
R2 overall	0.055	0.032	0.051	0.030	0.028	0.115

Notes:

- \*\*\* .0001;
- \*\* 0.01;
- \* 0.05;
- + 0.1

**Table 4**  
Institutional, school, principal and teacher factors associated with professional communities-- teacher collaborates in lesson planning

	Teacher collaborates in lesson planning					
	Model 1 Institutional	Model 2 Principal	Model 3 School	Model 4 Teacher-re	Model 5 Teacher-fe	Model 6 Everything-re
<b>Institutional Environment</b>						
Number of classes taught per week	0.903 <sup>+</sup> (0.489)				0.387 (0.448)	0.052 (0.060)
[Number of classes taught per week] SQUARED	-0.020 <sup>+</sup> (0.011)				-0.011 (0.010)	-0.001 (0.001)
Percentage of teachers' evaluation that is based on exam scores	0.016 <sup>+</sup> (0.008)				0.014 <sup>+</sup> (0.008)	0.002 <sup>+</sup> (0.001)
Reform implementation status	3.018 <sup>**</sup> (0.836)				2.804 <sup>**</sup> (0.817)	0.378 <sup>**</sup> (0.111)
Common office	0.415 (0.445)				0.376 (0.414)	0.050 (0.054)
<b>Principal characteristics</b>						
Years of principal education		-0.063 (0.141)			0.013 (0.133)	0.002 (0.018)
Principal years of teaching experience		0.036 (0.024)			0.020 (0.023)	0.003 (0.003)
Principal leadership scale		2.676 <sup>**</sup> (0.610)			2.509 <sup>**</sup> (0.559)	0.338 <sup>**</sup> (0.078)
<b>School socioeconomic status</b>						
Semester expenditure per student			0.000 (0.005)		-0.003 (0.004)	-0.000 (0.001)
Total number of teachers who teach classes			-0.002 (0.045)		-0.017 (0.035)	-0.002 (0.005)
Proportion of teachers with tertiary education			-1.453 (1.044)		-1.525 (0.993)	-0.206 (0.134)
Number of computers			0.036 (0.037)		0.003 (0.027)	0.000 (0.004)
Number of books in the library			0.000 (0.000)		-0.000 (0.000)	-0.000 (0.000)
Distance from county seat			0.006 (0.012)		-0.011 (0.010)	-0.002 (0.001)
<b>Teacher characteristics</b>						
Female teacher				-0.030 (0.282)	-0.134 (0.293)	-0.002 (0.037)
Teacher age				0.004 (0.015)	-0.002 (0.015)	0.006 (0.014)
Teacher from same town				0.373 (0.272)	0.304 (0.285)	0.363 (0.270)
Teacher is married				-0.156 (0.373)	-0.108 (0.387)	-0.231 (0.369)
Excellent teacher				0.297 (0.244)	0.152 (0.254)	0.142 (0.240)
Constant	-13.442 <sup>*</sup> (5.582)	-1.729 (2.177)	-1.593 <sup>+</sup> (0.843)	-2.051 <sup>**</sup> (0.605)		-6.660 (5.816)
Number of observations	646	646	646	646	442	646

Notes:



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**Table 5**  
Institutional, school, principal and teacher factors associated with professional communities-- teacher publishing

	Teacher has published an article					
	Model 1 Institutional	Model 2 Principal	Model 3 School	Model 4 Teacher-re	Model 5 Teacher-fe	Model 6 Everything-re
<b>Institutional environment</b>						
Number of classes taught per week	-0.348 (0.413)					0.034 (0.060)
[Number of classes taught per week] SQUARED	0.006 (0.009)					-0.001 (0.001)
Percentage of teachers' evaluation that is based on exam scores	-0.006 (0.008)					-0.002 (0.001)
Reform implementation status	1.224 (0.752)					0.020 (0.112)
Common office	0.899* (0.406)					0.047 (0.055)
<b>Principal characteristics</b>						
Years of principal education		0.271 <sup>+</sup> (0.149)				0.013 (0.020)
Principal years of teaching experience		0.001 (0.025)				0.002 (0.003)
Principal leadership scale		0.343 (0.614)				-0.074 (0.081)
<b>School factors</b>						
Semester expenditure per student			0.003 (0.004)			0.001 (0.001)
Total number of teachers who teach classes			0.038 (0.032)			0.006 (0.005)
Proportion of teachers with tertiary education			2.027** (0.767)			0.309* (0.134)
Number of computers			0.034 (0.026)			0.005 (0.004)
Number of books in the library			0.000 (0.000)			0.000 (0.000)
Distance from county seat			-0.005 (0.009)			-0.001 (0.001)
<b>Teacher characteristics</b>						
Female teacher				0.142 (0.275)	0.102 (0.279)	0.024 (0.038)
Teacher age				-0.000 (0.014)	0.003 (0.015)	0.000 (0.002)
Teacher from same town				0.516 <sup>+</sup> (0.269)	0.690* (0.275)	0.086* (0.034)
Teacher is married				0.822* (0.391)	0.747 <sup>+</sup> (0.401)	0.077 <sup>+</sup> (0.040)
Excellent teacher				0.810** (0.245)	0.849** (0.253)	0.120** (0.038)
Constant	2.553 (4.761)	-5.210* (2.302)	-2.974** (0.665)	-3.142** (0.651)	0.825** (0.243)	-8.745 (5.712)
Number of observations	646	646	646	646	448	646

Notes:

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